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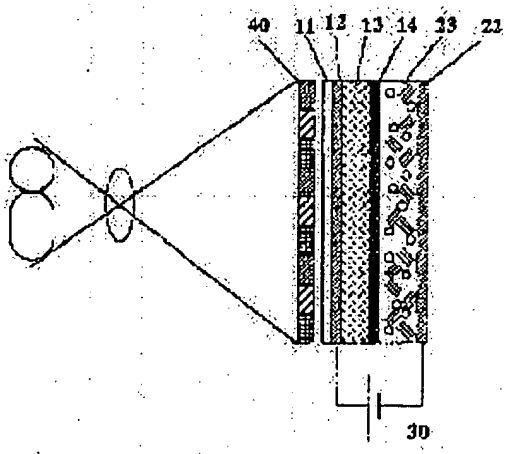
(54) COLOR IMAGE REPRODUCING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To erase unnecessary data and to efficiently reproduce a high-quality color image by obtaining information concerning the array of a color filter by utilizing the periodicity of image data, and extracting reproduced image data, based on the information.

SOLUTION: By performing image-exposure through the color filter 40 and impressing voltage between the electrodes 12 and 22 of the image recording medium, a full color image modulated by the filter 40 is recorded. The array where a black matrix is arrayed in a stripe state between the R, G and B filters in the stripe state is used as the array of the filter 40. In the case of reproducing the recorded image, the information concerning the array of the filter 40 is obtained by setting the picture element pitch of the filter 40 as a cycle, adding the image data in a specified phase and detecting the phase where an added value becomes maximal or minimal; or calculating correlation between the image data and a function setting the picture element pitch of the filter 40 as the cycle. Then, the reproduced image data is extracted based on the information and the image is reproduced.



LEGAL STATUS

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* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the approach of reproducing the full color image recorded on the image recording medium which has a photosensor and a liquid crystal record medium using a color filter.
[0002]
[Description of the Prior Art] Conventionally, what carries out opposite arrangement of the record medium in which the liquid crystal-macromolecule complex layer was formed on the electrode layer, and the photosensor, with which the photoconduction layer was formed on the electrode layer, and carries out image recording by electrical-potential-difference impression exposure is known.
[0003] Drawing 1 is drawing showing the configuration of the recording device which used such a record medium. Ten show a photosensor among drawing and 20 shows the record medium, respectively. The laminating of a transparent electrode 12 and the photoconduction layer 13 is carried out one by one on the transparence base material 11, the laminating of a transparent electrode 22 and the liquid crystal-macromolecule complex layer 23 is carried out one by one on the transparence base material 21, and, as for the photosensor 10, the skin 24 is formed in the liquid crystal layer front face, as for the record medium 20.
[0004] The thing of the type which carries out opposite arrangement of a photosensor and a record medium as shown in drawing 1 through an about 10-micrometer opening using spacers, such as polyethylene and polyimide, and carries out electrical-potential-difference impression exposure, As the structure which carried out the laminating of a photosensor and the record medium is also proposed as shown in drawing 2 (a) and drawing 2 (b), and it is indicated in drawing 2 (b) as what carries out the direct laminating of the liquid crystal recording layer on a photosensor as a laminating mold record medium shows to drawing 2 (a) There is a thing between which the intermediate phase 25 of a transparent dielectric is made to be placed. If opposite arrangement of a photosensor 10 and the record medium 20 is carried out, an electrical potential difference is impressed between two electrodes 12 and 22 according to a power source 30 in the thing of a configuration of having been shown in drawing 1 as shown in drawing 3 , and the light is irradiated as a write-in light The condition is maintained and record of an image is performed, even after the conductivity of the photoconduction layer 13 changes according to exposure reinforcement, the electric field concerning the liquid crystal layer 23 change, and the orientation condition of liquid crystal changes, turning off applied voltage and removing electric field.
[0005] Playback of the recorded image irradiates playback light from the light source 31 at a record medium 20, as shown in drawing 4 , and it is performed by reading the transmitted light with photo-electric-conversion equipment 33, and changing into an electrical signal. It is desirable to choose a suitable wavelength light with a filter 32, and to irradiate as a read-out light for which the sources of the white light and laser beams, such as a xenon lamp and a halogen lamp, are used and which is irradiated by the liquid crystal record medium as the light source 31. The light which carried out incidence is modulated according to the orientation condition of the liquid crystal of an information record medium,

the transmitted light is changed into a digital signal with the photo-electric-conversion equipment 33 which consists of a photodiode etc., and the changed signal is outputted to a printer or CRT if needed.
[0006] Moreover, a full color image is also recordable using such a record medium. This arranges the color filter which has the color scheme pattern of the shape of the shape of a mosaic, and a stripe in the photosensor side side of a laminating mold record medium as shown by drawing 2 , an image is projected through a color filter and a full color image is recorded by carrying out electrical-potential-difference impression.
[0007]
[Problem(s) to be Solved by the Invention] Since a record medium and a color filter dissociate at the time of image reconstruction and the information about a color is not recorded on a record medium by such approach when recording a color picture, it cannot judge which part of image data is equivalent to what color. Beforehand, even when the condition of the array of a color filter is known, it cannot predict to a gap of the rotation at the time of installing a record medium in picture reproducer, and the error of the migration precision of the direction of vertical scanning of picture reproducer.
[0008] This invention was made in view of this point, searches for the information about the array of a color filter using the periodicity of image data, extracts playback image data based on this information, and eliminates data without the need, and it aims at reproducing a high-definition color picture efficiently.
[0009]
[Means for Solving the Problem] When the image recorded on the image recording medium which has the photosensor from which this invention is modulated with a color filter, and conductivity changes with exposure reinforcement, and a liquid crystal record medium is reproduced, By making the pixel pitch of a color filter into a period, adding the image data in a predetermined phase, and detecting the phase from which an aggregate value serves as the maximum or the minimum Or by calculating correlation with image data and the function which makes the pixel pitch of a color filter a period, the information about the array of a color filter is searched for, and it is characterized by extracting and carrying out image reconstruction of the playback image data based on this information.
[0010] Moreover, this invention makes a period the pixel pitch of the color filter in the 2-way which intersects perpendicularly, respectively. By adding the image data in the predetermined phase in each period, respectively, and detecting the phase from which each aggregate value of a 2-way serves as the maximum or the minimum, respectively Or by calculating correlation with the image data in the 2-way which intersects perpendicularly, and the function which makes a period the pixel pitch of the color filter in a 2-way, respectively, respectively The information about the array of the color filter in a 2-way is searched for, and it is characterized by extracting and carrying out image reconstruction of the playback image data based on this information.
[0011]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained in detail using a drawing. Drawing 5 is drawing for explaining the image recording approach of this invention of having used the color filter. The color filter 40 is arranged just before the image recording medium, as shown in drawing. An image recording medium is a medium which has a photosensor which was explained by drawing 1 or drawing 2 , and a liquid crystal record medium, image exposure is carried out, between a photosensor and a liquid crystal record medium, liquid crystal carries out orientation by carrying out electrical-potential-difference impression, and an image is recorded. In this way, image exposure is carried out through a color filter 40, and the full color image modulated with the color filter can be recorded by carrying out electrical-potential-difference impression between the electrode 12 of an image recording medium, and 22.
[0012] That by which the black matrix 44 is arranged in the shape of a stripe between stripe-like R, G, and the B filters 41, 42, and 43 as an array of a color filter as shown, for example in drawing 6 can be used.
[0013] The record medium recorded by the approach of drawing 5 using the stripe filter is installed in the direction in which picture reproducer (scanner), and the direction and the direction of vertical

scanning of a stripe cross at right angles, and the result changed into the digital data is shown in drawing 7 . Drawing 7 chooses the data of one line of the direction of vertical scanning as arbitration, plots the part to the location of the direction of vertical scanning, and is data [in / R, G, and B of drawing, and / in BM / the location of a black matrix]. [the data of each color] As shown in drawing, since it becomes irregular with the light and the color filter from a photographic subject and the black matrix of a color filter exists, image data has periodicity.

[0014] Next, the example of the approach of acquiring the information about the array of a color filter is explained from the image data recorded using the stripe filter. The pixel pitch lambda (pixel) of the color filter which converted the pixel pitch of a color filter into the number of pixels of the direction of vertical scanning when the sampling pitch of the data of lambda 0 (micrometer) and the direction of vertical scanning of picture reproducer was set to xi (micrometer) is given by the degree type.

[0015] Lambda=lambda 0 / xi (pixel)

Since the array direction of a color filter and the direction of vertical scanning of picture reproducer do not lie at right angles completely, when a gap of the include angle at this time is set to psi in fact, a pixel pitch is lambda=lambda 0/(xi-cospsi). (pixel)

** -- it is amended like.

[0016] Next, how to acquire the information about the array of a color filter is explained using the periodic function obtained by doing in this way. the following periodic-function f(x) =sin(2pi-(x+delta x)/lambda)+1 [for example,] -- giving a definition -- the correlation lambda with this and image data D (x) -- lambda(delta x) =sigma {D(x) and f (x)}

It calculates by carrying out. delta x which gives lambda (delta x) with the biggest value expresses the location which has taken correlation most by calculating correlation by changing delta x in the range of -lambda<=delta x<=lambda at least. The location which gives the maximal value of a periodic function at this time, i.e., 2pi-(x+delta x) /lambda=pi/2+2npi, (n is an integer)

The becoming location is equivalent to the center of filter location of each color.

[0017] Moreover, partial [which a periodic function gives the minimal value], i.e., 2pi-(x+delta x)/lambda, =-pi/2+2npi (n is an integer)

The becoming location is equivalent to the location of a black matrix.

[0018] The result of having calculated correlation is shown in drawing 8 using the image data shown in drawing 7 . As shown in drawing, to delta x, the correlation function of lambda is obtained and a period can detect the location of a color filter and a black matrix from the maximal value of such a correlation function, and the minimal value. Thus, the result of having piled up a periodic function and image data is shown in drawing 9 using the acquired value delta x. Drawing 9 shows that correlation of a periodic function and image data can be taken.

[0019] Moreover, although the trigonometric function was used as a periodic function, there is especially no limit in the class of function, and all periodic functions can be used here.

[0020] As mentioned above, although what is necessary is to take only the direction of vertical scanning into consideration with a stripe type filter, to be the filter of the mosaic type with which it was divided by the black matrix arranged in the shape of a grid, and R, G, and B filter were arranged, it is necessary to take into consideration the 2-way of horizontal scanning and vertical scanning. However, the view and the count approach are the same as the case of a stripe.

[0021] The system of coordinates to which the x axis and the main scanning direction made the direction of vertical scanning the y-axis are considered. The pixel pitch of a color filter is set to lambdaX0 and lambday0, respectively. They are xi x and xiy about the sampling pitch of picture reproducer. If it carries out, the pitch (pixel) of the color filter in a playback image system will be given by the degree type.

[0022] Lambda=lambda X0/xix (pixel)

Lambda=lambda y0/xiy (pixel)

When a gap of the include angle of the system of coordinates of a regenerative apparatus is set to psi, a period is expressed as the array direction of a color filter like a degree type.

[0023]

Lambda=lambda X0/(xix and cospsi) (pixel)

Lambda=lambda y0/(xiy and cospsi) (pixel)
The following periodic functions are considered like the case of a stripe filter.
[0024]
f(x) =sin{2pi- (x+delta x) / lambda x}+1f(y) =sin{2pi-(y+deltay)/lambday}+1 -- respectively -- the correlation lambda with f (x), f (y), and image data D (x y) -- lambda(delta x) =sigma {D(x y) andf (x)} lambda(deltay) =sigma {D(x y) andf (y)}
** -- it calculates like. deltax and delta y are changed and it asks for deltax and delta y from which lambda (delta x) and lambda (deltay) become the maximum. As 2pi-(x+delta x)/lambdax =pi / coordinate (x y) with which 2+2n is set to pi2pi-(y+deltay)/lambday =pi/2+2npi, and it is satisfied of this shows the conditions which give the maximal value to drawing 10 , it becomes the main coordinate of a color filter. moreover, 2pi-(x+delta x)/lambdax =-pi/2+2npi2pi-(y+deltay)/lambday =-pi/2+2npi -- giving (x y) -- equivalent to the coordinate of the intersection of the black matrix of a color filter, as shown in drawing 10 .
[0025] In addition, in the above-mentioned example, although correlation with the periodic function and image data like a trigonometric function is calculated, even if it calculates only the sum of image data simply, the same result is obtained. If a stripe filter is made into an example and explained, the pitch of a color filter will be converted into the number of pixels of the direction of vertical scanning of a playback image system, and it will be referred to as lambda (pixel). When lambda is an integer, it is lambda(delta x) =sigmaD (n lambda+delta x) simply. (0 <=delta x<=lambda) (n is an integer)
delta x from which it calculates, the delta x will become the center position of a color filter if it is made delta x (phase) from which lambda (delta x) becomes the maximum, and lambda (delta x) becomes the minimum becomes the location of a black matrix. As for this, the same is said of the case of a mosaic pattern (the direction of vertical scanning and a main scanning direction are also taken into consideration).
[0026] When lambda is not an integer, since n lambda+delta x is not a sampling point by picture reproducer, data do not exist. Therefore, if it is made to calculate by choosing a suitable pixel from the pixel before and behind that in this case, it is computable similarly.
[0027] Next, the sampling of the data based on picture reproducer is explained. It is more desirable to make the pixel of a CCD sensor small to the pixel of a color filter as much as possible, in order to measure the array of the pixel of a color filter correctly. However, if 5-6-pixel CCD is assigned and recorded to the pixel of a color filter so that it may be shown in such a case, for example, drawing 10 , and it will be image data only at the core of the pixel of a color filter, the granular noise of a proper, and when it is recorded with gradation nature and is in the pixel of a color filter again, the pixel of the color filter may not be correctly represented in a liquid crystal record medium. It is more desirable to have equalized a core and the effective data of the circumference of it and to consider as the data of the pixel, in order to prevent such a thing. Moreover, to the pitch of a color filter, when the pixel pitch of CCD is sufficiently small, the average of all the pixels in a color filter may be calculated. Moreover, the wave of the data in a color filter is approximated to a suitable function (a trigonometric function, gauss function) etc., and it is good also considering the amplitude as image data. Moreover, in equalizing two or more data in this way, there are an approach of equalizing these data simply and a method of giving the difference in weight in a core and a circumference part. Although an operation is simple for former one, latter one cannot be easily influenced of a boundary part.
[0028] Next, a playback algorithm is explained. It needs to be parallel and it is necessary to perform the analysis of the array of a color filter, and the sampling of data, and in an actual image reconstruction system, while scanning the whole, it is necessary to devise so that data volume may not become large. When the case of a mosaic filter is made into an example, an image is disassembled into some blocks B11 and B21 .... like drawing 11 , the array situation of a color filter is analyzed for every block, required image data is sampled by the analysis result, and it is made for data volume not to become large by eliminating data without the need.
[0029] Moreover, when the image of the part equivalent to a certain block is dark, even if it calculates correlation, since the difference is small, the dependability of a count result may not be acquired. In such

a case, data are sampled with reference to the array situation of the color filter of a surrounding block.
[0030] Drawing 12 is drawing explaining such a playback algorithm, and it calculates correlation by it carrying out A/D conversion of the signal reproduced by CCD for every block first, and changing a phase. The dependability over this result is judged at this time. This judgment function gives the level judging function of image concentration to picture reproducer, and it is made to make the dependability of data judge by whether there is any image concentration more than predetermined level. If there are reliable data, based on it, deltax and delta y will be calculated, the array of a color filter will be presumed, and image data will be produced. When a problem is in dependability, the data deltax and delta y of a surrounding block are read and referred to, the array of a color filter is analyzed, and image data is produced. Thus, both array situations (a pitch, phase) of image data and a color filter are recorded, and image data is produced one by one by the same approach also to the following block.
[0031]
[Effect of the Invention] In case the image recorded using the color filter is reproduced as mentioned above according to this invention, the array of a color filter is detected and it becomes possible to obtain a high-definition color picture efficiently by extracting and carrying out image reconstruction of the playback image data based on the detected information.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of an information recording device.
[Drawing 2] It is drawing showing the configuration of a laminating mold record medium.
[Drawing 3] It is drawing explaining record of exposure information.
[Drawing 4] It is drawing explaining playback of exposure information.
[Drawing 5] It is drawing explaining the image recording approach using a color filter.
[Drawing 6] It is drawing showing a stripe filter.
[Drawing 7] It is drawing showing the playback output of the image recorded using the stripe filter.
[Drawing 8] It is drawing showing the result of having calculated correlation.
[Drawing 9] It is drawing showing the result of having piled up a periodic function and image data.
[Drawing 10] It is drawing explaining the relation between a color filter and the pixel of a CCD sensor.
[Drawing 11] It is drawing explaining playback of the image in the case of a mosaic filter.
[Drawing 12] It is drawing explaining a playback algorithm.
[Description of Notations]
41, 42, 43 -- A color filter, 44 -- Black matrix.

[Translation done.]

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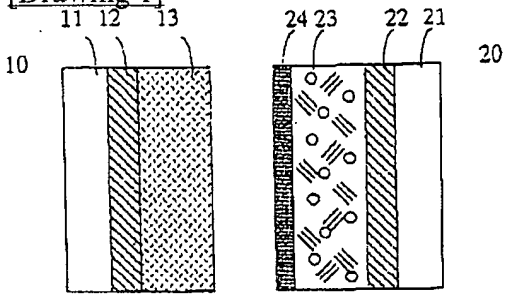
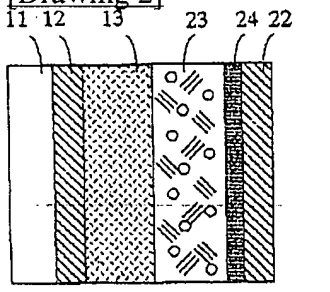
DRAWINGS

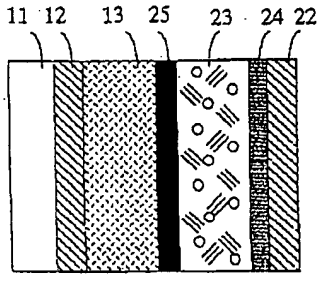
[Drawing 1]



[Drawing 2]

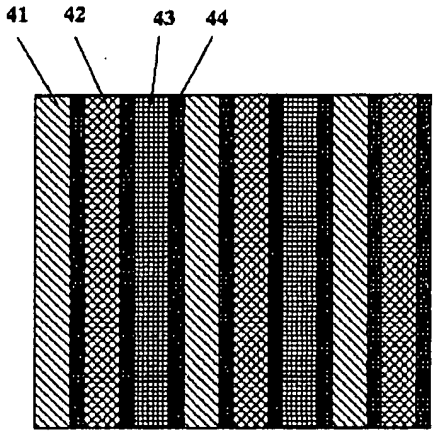


(a)

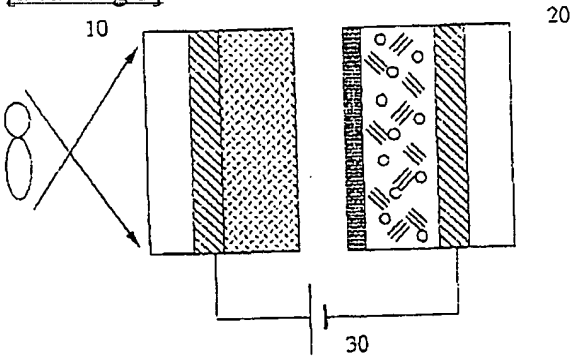


(b)

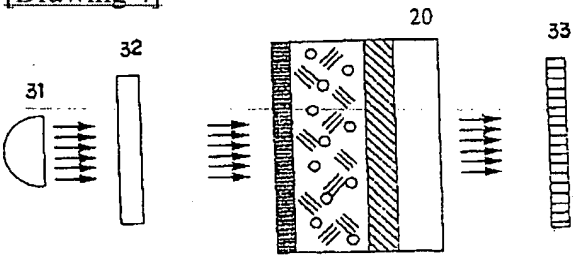
[Drawing 6]



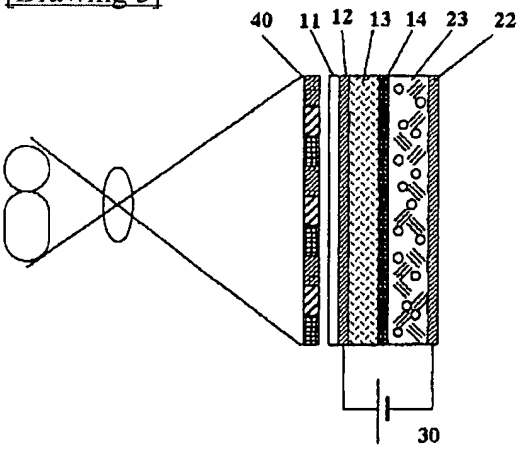
[Drawing 3]



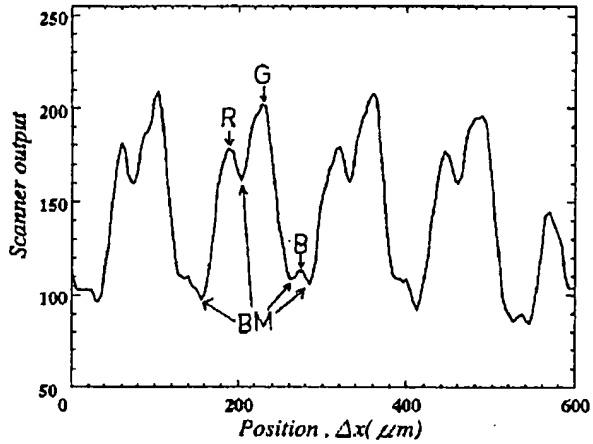
[Drawing 4]



[Drawing 5]



[Drawing 7]



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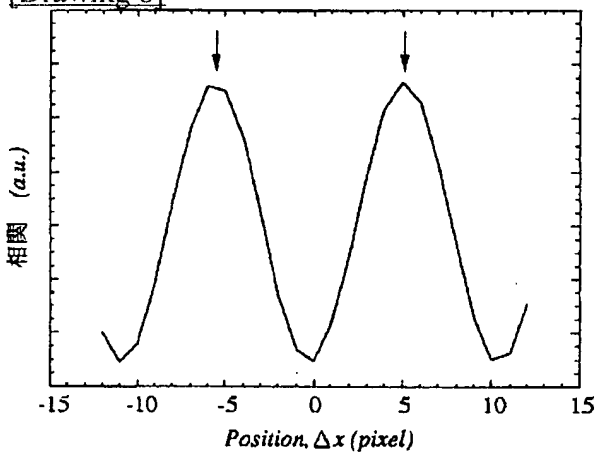
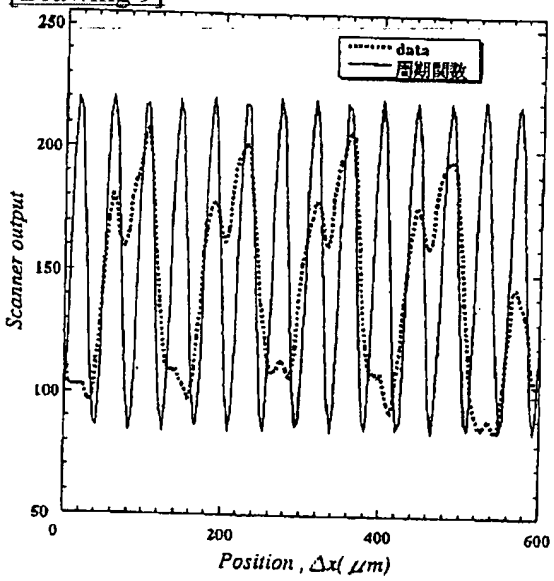
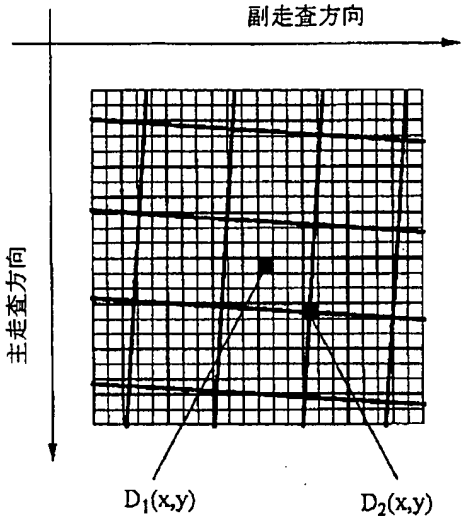


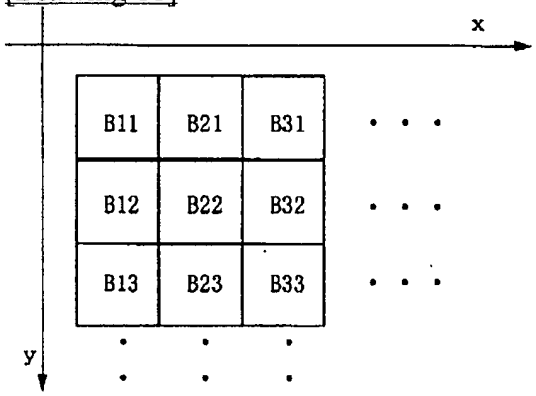
[Drawing 9]



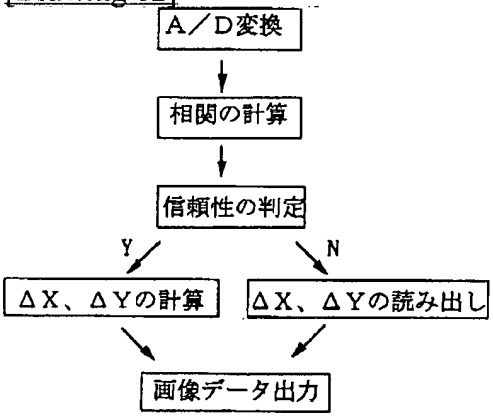
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]